DOCUMENT RESUME

ED 348 044 IR 053 397

AUTHOR Crowley, Steven J.
TITLE A Review of Talking Book Technology.
INSTITUTION du Treil, Lundin & Rackley, Inc., Washington, DC.
SPONS AGENCY Library of Congress, Washington, D.C.
PUB DATE 7 Sep 90
NOTE 14p.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Accessibility (for Disabled); *Audiodisks; *Audiotape Cassettes; *Library Services; *Optical Data Disks; *Talking Books; *Technological Advancement; Visual Impairments
IDENTIFIERS *Audio Compression; Digital Audiotape; National Library Service for the Blind

ABSTRACT

A review of talking book technology has been conducted. This review concludes that present talking book technology in the form of analog cassettes and flexible discs is, today, the most viable for the program. The overall trend of audio technology toward digitization continues, and will likely some day be practical for use in talking book programs at the patron level. Today, for example, the compact disc is becoming the dominant audio technology at the consumer level. Traditionally, the talking book program has benefitted from the economies of established consumer technology. However, in terms of flexibility, ease of use, and economy, the compact disc and other digital technologies are not now suitable. Research in audio compression has the potential to benefit a digital implementation of the talking book program. An overview of this technology concludes this report. (Author)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

A REVIEW OF TALKING BOOK TECHNOLOGY

prepared for

THE LIBRARY OF CONGRESS

IVED

1 1990

September 7, 1990

IR053397

du Treil, Lundin & Rackley, Inc.

BEST COPY AVAILABLE

TABLE OF CONTENTS

		Page
	Summary	ii
1.	Past Talking Book Technology	1
2.	Present-Day Technology	2
3.	Present Alternative Technology	4
4.	Future Technology	8
5.	Conclusion	10

SUMMARY

A review of talking book technology has been conducted. This review concludes that present talking book technology in the form of analog cassettes and flexible discs is, today, the most viable for the program.

The overall trend of audio technology toward digitization continues, and will likely some day be practical for use in talking book programs at the patron level. Today, for example, the compact disc is becoming the dominant consumer audio technology for consumers level. Traditionally, the talking book program has benefitted from the economies of established consumer technology. However, in terms of flexibility, ease of use, and economy, compact disc and other digital technologies are not now suitable.

Research in audio compression has the potential to benefit a digital implementation of the talking book program. This report provides an overview of this technology.

A REVIEW OF TALKING BOOK TECHNOLOGY

prepared for

THE LIBRARY OF CONGRESS

The firm of du Treil, Lundin & Rackley, Inc. has been retained by The Library of Congress to examine the suitability of present-day talking book technology used by the National Library Service for the Blind and Physically Handicapped (NLS).

Research for this project included inspection of NLS facilities in Washington. During this visit, playback equipment used in the talking book program was demonstrated, and several discussions were had with NLS technical and administrative staff. During the inspection, and afterwards, NLS staff was completely responsive to requests for information regarding NLS programs and technology. Their cooperation is gratefully acknowledged.

1. PAST TALKING BOOK TECHNOLOGY

Throughout the history of the talking book program -- both in its start by the American ~~Federation~~ Foundation of the Blind and its development by the Library of Congress -- talking book technology has taken advantage of technical advances in consumer audio electronics. Reliance on existing technology, with modifications as appropriate, has minimized the cost of introducing talking book technology.

The first use of records in the talking book programs was spurred by technological developments in the phonograph industry. Thereafter, improvements were again spurred by the consumer market, such as when ceramic cartridges were introduced as an improvement to crystal cartridges.

The introduction of the Philips-Norelco type cassette in the NLS program in 1969 took place only after cassette players were widely available at relatively low cost. This common format increased the ease with which volunteers could record tapes and regional libraries copy them.

Talking book technology not rooted in widespread technology did not fare as well. One example is the Magna Book Mark II. This device used a non-standard cartridge which contained two stacked reels of tape. The machine never went beyond the prototype stage due to technical problems. Another example was the XP-1 (experimental player), which used a non-standard coaxial-reel cassette. The prototype of this machine was determined to be too complex, and was not put into production.

2. PRESENT-DAY TECHNOLOGY

Presently, two media are used by NLS for distribution in the talking book program -- cassettes and records. As of 1987, rigid disks have not been produced, and all magazines issued by NLS have used the flexible-disk format. Due to the speed with which they can be manufactured, flexible disks are used to deliver time-sensitive books such as magazines and best sellers to the user in a timely manner. All books that would have been recorded in rigid-disk format are now being produced on cassette.

Five machines are used by NLS. The Talking Book Machine plays recorded disks at 8 1/3 rpm, 16 2/3 rpm, and the standard commercial speed of 33 1/3 rpm. It is used to play flexible disks. The slower speeds are used to increase playing time and to make the disks unplayable on standard equipment, thus

alleviating copyright concerns. This machine has four controls and is simple to operate.

The Standard Cassette Machine plays 15/16 ips and 1 7/8 ips, two-track and four-track tapes. It has ten controls, including a variable speed control, and is fairly complex to operate. It is portable and includes a rechargeable battery. The slower speed is used to increase playing time and satisfy copyright concerns.

The C-80 Cassette Machine includes features identical to the Standard Cassette Machine except for the addition of a pitch-restoration device that retains near-normal voice pitch while increasing or decreasing the playback speed. There is an increase in distortion, however, that varies with the degree of change from standard speed. It is intended for the use of those who need to cover much material in a short time.

The Easy Cassette Machine plays only 15/16 ips 4-track tapes. It includes automated functions; for example, it automatically rewinds cassettes and changes tracks. This automation means it lacks some of the versatility of the Standard Cassette Machine. It is designed primarily for those whose disability makes use of the Standard Cassette Machine difficult.

The newest playback device is the Combination Machine, which has all the features of the Standard Cassette Machine and the Talking Book Machine in a single unit. It has fast-forward, reverse, and variable speed features that can be used with both cassettes and disks. It has eleven controls, and is fairly complex to use. It is capable of battery operation. In its first run, 1000 units are being produced with an erasable control memory for evaluation purposes. Once the control software is tested, the unit will be produced in greater quantities with noneraseable memory.

NLS flexible-disk and cassette formats offer several advantages. Cassette and record playback machines are relatively inexpensive. Cassettes are easily duplicated and replaced by regional libraries. The NLS four-track format has become a worldwide medium making possible international interlibrary loans. It is the format standard of Australia, Canada, Ireland, South Africa and New Zealand. Twenty-one other countries have acquired U.S. four-track players.

Disadvantages are the same as those with any tape or record format. Tapes wear and can jam. Playback machines require cleaning of tape heads and other parts in contact with the tape for best performance. With the flexible disc format, wear occurs to needles and discs.

3. PRESENT ALTERNATIVE TECHNOLOGY

As discussed above, developments in consumer audio technology have influenced the advancement of talking book equipment. This pattern can be expected to continue, so it is natural to look at recent developments in consumer electronics for potential directions of talking book technology. One trend is clear: the digitization of consumer electronics and telecommunications.

Compact Disks

Today, the compact disk (CD) is becoming the dominant consumer medium for audio playback. Compact disks have several advantages over records and tapes. Audio specifications for frequency response, dynamic range, and noise are superior. For example, frequency response extends from 20 to 20,000 hertz -- about the range of human hearing. With proper care, compact disks can last indefinitely since no physical contact is required between the CD and the player's optical transducer.

Many of these advantages, however, would not benefit NLS talking book program. For example, voice reproduction requires a frequency response with an upper limit of 5,000 to 10,000 Hz, depending on the quality desired. Also, it is probably desirable to compress the dynamic range of talking books to present a consistent audio level to the user. Much of the capacity of the standard compact disk format would thus be wasted.

Though talking books require about six hours playing time, the standard CD format only has a capacity of slightly over an hour. The most efficient implementation of talking book technology by compact disk would be through a different CD format such as CD-I. The Adaptive Pulse Coded Modulation Level C format for CD-I is capable of storing approximately 18 hours of monaural audio with a frequency response to 8,500 hertz.

When considering CDs, a major concern is the reliability of the compact disk itself. Though compact disks can last indefinitely, they sometimes do not. If scratched, they can be rendered unusable. Even if they aren't permanently damaged, their handling requirements for trouble-free performance are more strict than those for a cassette tape. Fingerprints and dust can make a compact disk unplayable. Specialized cleaning techniques must be then be used; for example, the motion of a cleaning cloth should be in a radial direction rather than one following the curved path of the CD data -- this is so that any minute scratches introduced by the cleaning process will not corrupt more audio data bits in a row than are recoverable by the player's error-correction system.

In many respects, then, the compact disk is more fragile than a cassette tape. The player, too, is subject to contamination much as occurs with an audio tape player. This occurs when dust or particulate matter from tobacco smoke coat

the lens of the optical pickup in the CD player. The first symptoms of this are when the CD starts mistracking, or "skipping", much as occurs with a scratched record.

These problems are well known in the radio broadcasting industry, where the compact disk is becoming common. After conversion to this medium, some stations discovered they had more problems than they did with records or tapes. There are solutions to these problems, but all are quite expensive and introduce inflexibility. These include no-smoking policies and regular cleaning of CDs and players.

CD player manufacturers have responded with professional players designed to better overcome tracking errors in the presence of bad data from the CD. To help prevent contamination, systems have been developed where all of a station's CDs are stored in sealed rotating trays. The appropriate CD is selected from a keypad and thus does not have to be touched.

Another manufacturer has introduced a system that [illegible] CD from contamination by encasing each one in its own cartridge, about the size of a standard CD case. The announcer thus never touches the CD itself. A similar cartridge system is being developed by compact disk manufacturers for use in background music system in stores. This type of user interface would be logical for use with the talking book program. The specialized players, however, now cost approximately $3,000.

Another concern regarding compact disks is the ability to make copies at regional library locations, and the ability of outside parties to make recordings for use by the talking book program. Equipment to record CDs in their standard format costs approximately $50,000 -- well beyond that required for cassette tape duplication. Implementation of CD technology at this time

may thus reduce the ability to make copies of compact disks outside of a central location. Third parties, however, would still be able to record audio tapes that could be transferred to compact disk at a central facility.

A CD player for NLS patrons would have to be a custom model in order to maintain flexibility and ease of use. It is estimated that the cost of such a player would be not less than $500, and that figure does not include research and development costs. This cost is several times that of existing talking book players.

Media cost is another one of those factors that, in itself, appears to make compact disk technology unsuitable at this time. Nonrecordable compact disks can be mass-produced at a cost of approximately $3 in quantities of several thousand, but these quantities are inappropriate for NLS needs. Recordable CDs today cost approximately $40 each.

Digital Audio Tape

Digital audio tape (DAT) is also a potential technology for use by the talking book program. Because of its capability to make perfect recordings, DAT was initially opposed by the Recording Industry Association of America. The Electronics Industries Association (EIA) and the RIAA have reached an agreement to incorporate into the DAT machines technology to limit unauthorized recording.

In June, 1990, Sony Corporation launched a marketing campaign around its consumer DAT recorders. These have a retail price of about $1000. Now, the DAT fight has been renewed with the filing of a lawsuit against Sony by several music publishers who are concerned about unauthorized recording. Sony and EIA expect that the legal challenge can be withstood, based on legal

precedent established when a similar suit was filed against Sony when the company introduced video cassette recorders in the 1970s.

These legal problems have slowed the adoption of DAT technology, as have reports of compact-disk recorders under development for consumer use. Thus, DAT has not seen the economies of mass production prevalent in the CD area. DAT shares some of the problems of standards audio cassettes. The tapes wear out over time and machine cleaning is still required. CD would be a preferred media over DAT for NLS talking books, but still not preferred over standard cassette tapes at this time.

Digital Transmission

An alterative to hard media is the transmission of audio data through telecommunications systems, such as telephone lines or radio links. In such a scheme, the user would select which talking book source material was desired, and it would be sent over a telecommunications channel. This year, three companies have introduced CD quality digital music services for cable television systems. In those systems, data are transmitted via satellite to the cable system transmission facility, and the audio data are then sent over cable to the consumer.

Today, these schemes are unsuited to the talking book program due to the nationwide telecommunications infrastructure that would be required for a limited number of users. In the distant future, the talking book program may be able to take advantage of an integrated nationwide digital communications network.

4. FUTURE TECHNOLOGY

Present research in audio technology includes several areas that will some day likely be of benefit to the talking book program. These advances are being driven in part by development of improved methods into radio broadcasting, where systems have been developed that can offer compact disk quality sound over the air while making much more efficient use of the electromagnetic spectrum than has previously been possible.

This efficiency is reached in part through reducing the amount of data required to represent audio by taking advantage of psychoacoustic masking. In masking, the closer two tones are in frequency, the greater the likelihood that the louder tone will mask the softer tone. Several sound coding techniques have been developed to imperceptibly eliminate details of audio that can't be heard. Though implemented through different digital algorithms, they all follow the same principles. First, analog audio is converted to digital data. Then, the data are analyzed to determine which loud sounds are masking which softer sounds, based on a model of human psychoacoustic characteristics. The loud sounds are kept and the softer sounds ones that can't be heard are discarded as irrelevant information. Additionally, the amount of data representing perceptible sounds is reduced; this increases noise in the audio, but not enough to rise above the threshold of hearing. The International Standards Organization is in the process of selecting a standard among various bit-reduction algorithms, with selection due around December, 1990. The leading techniques offer a six-fold reduction in the bit rate, allowing compact-disk quality monaural audio to be carried by a 128 kilobits per second bit stream with no subjective degradation. Research continues in an effort to reduce this bit rate to 64 kilobits per second.

This analysis and restructuring of audio takes a great deal of computational power, but the increasing economies of digital signal processing (DSP) are making it practical for consumer use. DSP of the scope required for this processing of audio used to require prohibitively large computers. Today, the necessary devices are available on integrated circuits. They now appear in some compact disk players where they are used to adjust the tonal characteristics of the digital audio data before they are converted to analog form. Increased usage these devices means they could become economical for talking book program technology, and greatly increase the recording capacity of digital media.

5. CONCLUSION

Existing talking book technology, in the form of analog cassettes and flexible disks, is today the most suitable for patrons of the NLS talking book program.

The overall trend in communications technology towards digitization continues. It will likely some day be suitable for talking book playback devices. In its present form and cost, however, it is inviable.

Steven J. Crowley
Technical Consultant

du Treil, Lundin & Rackley, Inc.
1019 19th Street, N.W. Suite 300
Washington, D.C. 20036
(202) 223-6700

September 7, 1990